

REMARKS***Summary of the Amendment***

Upon consideration of Applicants' present remarks, claims 14 - 37 will currently remain pending.

Summary of the Official Action

In the instant Office Action, the Examiner has rejected claims 14 - 37 over the art of record. By the present remarks, Applicants submit that the rejections have been overcome, and respectfully request reconsideration of the outstanding Office Action and allowance of the present application.

Renewed Request for Acknowledgment of Receipt of Certified Copy of Priority Document

Applicants again request that the Examiner acknowledge receipt of the certified copy of the German priority document from the International Bureau. In this regard, Applicants note that the December 8, 1999 Notification of Missing Requirements Under 35 U.S.C. § 371 in the United States Designated/Elected Office (DO/EO/US) confirms receipt of the priority document, and Applicants request that the Examiner formally acknowledge the same to ensure that Applicants' claim of priority is in order.

Traversal of Rejection Under 35 U.S.C. §102(e)

Applicants traverse the rejection of claims 14 - 17, 20 - 22, 27 - 29, 31 - 35, and 37 under 35 U.S.C. § 102(e) as being anticipated by ADAMS (U.S. Patent No. 5,583,904). The Examiner asserts that ADAMS shows X-ray inspecting a test object in which the test object

is fixed in a stationary position throughout inspection and the X-ray tube and detector are linearly movable in parallel X - Y planes. In particular, the Examiner has noted column 14, lines 45 - 67 and Figure 8. Applicants traverse the Examiner's assertions.

The present invention prevents much of the unintended damage to soldering joints that occurs in known inspection devices, i.e., devices in which the X-ray beam source and detector were fixedly mounted within an inspection chamber and the test piece was movably mounted within the inspection chamber. These arrangements required the test piece to move so that the various soldering joints of the test piece would fall within the X-ray beam for joint testing. However, due to the jostling/jarring of the test piece during the stopping and starting of the movement within the inspection chamber the inventors found that the soldering joints were being loosened and/or broken, and, unfortunately, when the joints were loosened and/or broken after inspection, these subsequent defects were not detected. As a result a defective test pieces was deemed acceptable.

To address this deficiency of the prior art, the present invention is directed to a device and process in which the test piece is fixedly mounted in a stationary position throughout the inspection process, whereby the inadvertent loosening and/or breaking of soldering joints is substantially eliminated. However, because the test piece is fixedly mounted, the X-ray beam source and detector are mounted for linear movement in order to inspect each soldering joint located on the test piece. As discussed in the specification between page 5, line 14 and page

6, line 4, while movement of the X-ray beam source and detector is generally considered problematic, the present invention addresses and solves such problems by using an X-ray beam tube without a vacuum pump or cooling and a device for horizontally moving the X-ray beam tube and detector to ensure that these components are moved with great accuracy and at high speeds despite their large mass.

Accordingly, Applicants independent claim 14 recites, *inter alia*, the at least one test object is *fixed in a stationary position throughout the inspection*, and said X-ray beam tube and said detector are *linearly moveably arranged within parallel X-Y planes* for inspecting an entire area of the at least one test object. Further, Applicants independent claim 32 recites, *inter alia*, *fixedly mounting the at least one test object in a stationary position throughout the inspecting of an entire area of the at least one object*, and *linearly moving the X-ray beam tube and the detector within parallel X-Y planes*, thereby inspecting the entire area of the at least one test object. Applicants submit that ADAMS fails to anticipate at the least the above-noted features.

Applicants note that, in contrast to previous Office Actions, the Examiner now refers to Figure 8 of ADAMS as showing each and every feature recited in the above-identified claims. While acknowledging that ADAMS shows movement of the X-ray beam and detector, Applicants note that Figure 8 and the associated text of ADAMS show the two X-ray sources 10 and 20 being attached to upper arm 602 of “C” shaped bracket 604, such that

these sources are arranged in a common plane. As a result, Applicants note that ADAMS provides no disclosure of an X-ray beam tube and detector that are linearly movably arranged within parallel X -Y planes, as recited in at least independent claims 14 and 32.

Moreover, Applicant notes that ADAMS provides no alternative arrangement in which the sources 10 and 20 are located in a coplanar manner, such that ADAMS does not even arguably suggest the arrangement recited in the independent claims.

Because ADAMS fails to disclose each and every recited feature of at least independent claims 14 and 32, Applicants submit that this document fails to anticipate the present invention. Therefore, Applicants submit that the Examiner has failed to provide an adequate evidentiary basis to support a rejection of anticipation under 35 U.S.C. §102(e).

Further, Applicants submit that claims 14 – 17, 20 – 22, 27 – 29, 31 – 35, and 37 are allowable at least for the reason that these claims depend from allowable base claims and because these claims recite additional features that further define the present invention. In particular, Applicants submit that ADAMS fails to anticipate, *inter alia*, a carrier adapted to be fixedly mounted throughout the inspection of the at least one test object, wherein said carrier is coupled to the at least one test object during the inspection, as recited in claim 15; a computing device being coupled to said detector, as recited in claim 16; an analysis unit being connected to said computing device, as recited in claim 17; said X-ray beam tube and said detector are adapted for two-dimensional inspection of the test object, as recited in claim

20; said X-ray beam tube and said detector are adapted for three-dimensional inspection of the at least one test object, as recited in claim 21; the at least one test object comprises at least one of a printed circuit board and a loaded printed board assembly, as recited in claim 22; said X-ray beam tube and said detector are adapted to move parallel to each other, as recited in claim 27; said X-ray beam tube and said detector are adapted to move together in a same direction, as recited in claim 28; said X-ray beam tube and said detector are adapted to move in a same direction, as recited in claim 29; said X-ray beam tube and said detector are adapted to move parallel to the at least one test object, as recited in claim 31; linearly moving the X-ray beam tube and the detector parallel to each other, as recited in claim 33; linearly moving the X-ray beam tube and the detector together in a same direction, as recited in claim 34; linearly moving the X-ray beam tube and the detector a same direction, as recited in claim 35; and linearly moving the X-ray beam tube and the detector parallel to the at least one test object, as recited in claim 37.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 14 – 17, 20 – 22, 27 – 29, 31 – 35, and 37 under 35 U.S.C. §102(e) and indicate that these claims are allowable.

Traversal of Rejection Under 35 U.S.C. §103(a)

1. Over Adams in view of Neubauer

Applicants traverse the rejection of claims 18, 19, 23, and 24 under 35 U.S.C. § 103(a) as

being unpatentable over ADAMS in view of NEUBAUER et al. ("X-Ray Inspection of Solder Joints by Planar Computer Tomography) [hereinafter "NEUBAUER"]. The Examiner asserts that, while ADAMS does not recognize the X-ray beam tube having a microfocus tube with focal spot diameter of 10 to 40 microns, NEUBAUER shows such a beam tube. Applicants traverse the Examiner's assertions.

Applicants note that in order to operate in its intended manner, ADAMS emits an angular spread of radiation from sources 10 and 20. Moreover, Applicants submit that the art of record fails to provide any teaching or suggestion that, if modified in the manner asserted by the Examiner, the modified ADAMS would continue to operate in its intended manner. That is, while the Examiner has found individual features in the art of record, there is no teaching or suggestion that utilizing the NEUBAUER X-ray source would provide the necessary source/receiver capabilities required by Figure 8 of ADAMS, or whether the NEUBAUER X-ray source would effectively operate in the manner set forth by angular spread of radiation disclosed by ADAMS.

Moreover, Applicants note that NEUBAUER fails to provide any teaching or suggestion of the subject matter noted above as deficient in ADAMS with respect to at least independent claim 14. Because neither applied documents teaches or suggests the above-noted features, Applicants submit that no proper combination of the applied art can even arguably render unpatentable the combination of features recited in the instant claims.

Further, Applicants submit that claims 18, 19, 23, and 24 are allowable at least for the reason that these claims depend from allowable base claims and because these claims recite additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of NEUBAUER teaches or suggests, *inter alia*, said X-ray beam tube comprises a microfocus tube with a focal spot diameter of 10 to 40 μm , as recited in claim 18; said detector comprises a CCD chip arranged on a taper, as recited in claim 19; said device is adapted for X-ray inspection of soldered joints on at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 23; and said device is adapted for fully automated 100% X-ray inspection of soldered joints on at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 24.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 18, 19, 23, and 24 under 35 U.S.C. §103(a) and indicate that these claims are allowable.

2. Over Adams in view of Armistead

Applicants traverse the rejection of claim 25 under 35 U.S.C. § 103(a) as being unpatentable over ADAMS in view of ARMISTEAD (U.S. Patent No. 4,852,131). The Examiner asserts that ARMISTEAD shows the use of learned characteristic vectors, and that it would have been obvious to modify ADAMS to include such a feature. Applicants traverse the Examiner's assertions.

Applicants note that ARMISTEAD discloses a scanning beam through which a test piece is moved and a beam source and detector that are fixedly mounted. Thus, Applicants submit that ARMISTEAD fails to provide any teaching or suggestion of the subject matter noted above as deficient in ADAMS with respect to at least independent claim 14. In this regard, Applicants note that ARMISTEAD fails to teach or suggest linearly moving a detector and source in parallel planes, and fails to disclose any motivation or rationale for doing so in a system such as ADAMS.

Thus, Applicants submit that, as neither applied document teaches or suggests the above-noted features, no proper combination of the applied art can render unpatentable the combination of features recited in at least independent claim 14. Further, Applicants submit that, as the art of record fails to provide the requisite motivation or rationale for modifying ADAMS in the manner asserted by Examiner in the instant Office Action, the asserted rejection is improper and should be withdrawn.

Further, Applicants submit that claim 25 is allowable at least for the reason that it depends from an allowable base claim and because it recites additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of ARMISTEAD teaches or suggests, *inter alia*, an analysis unit coupled to said detector, said analysis unit including a learning mode, so that, in said learning mode, a set of testing algorithms is transmitted to the analysis unit, and the algorithms are used to

generate a characteristic vector for an individual soldered joint that is optimized to statistically represent a defect-free soldered joint, such that the characteristic vector is optimized by analyzing vectors of a same soldered joint on other at least one of printed circuit boards and loaded printed board assemblies, as recited in claim 25.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claim 25 under 35 U.S.C. §103(a) and indicate that this claim is allowable.

3. Over Adams in view of Armistead and further in view of Rooks

Applicants traverse the rejection of claim 26 under 35 U.S.C. § 103(a) as being unpatentable over ADAMS in view of ARMISTEAD and further in view of ROOKS (U.S. Patent No. 5,719,952). The Examiner asserts that ROOKS shows the use of a frame or pad image buffer, and that it would have been obvious to modify ADAMS and ARMISTEAD to include such a feature. Applicants traverse the Examiner's assertions.

Applicants note that, in contrast to the instant invention, ROOKS discloses a fixedly positioned rotating beam source and a fixedly positioned rotating detector in which a test piece is moved through a focal plane between these fixed rotating elements. Thus, Applicants submit that ROOKS fails to teach or suggest the subject matter noted above as deficient in the asserted combination of ADAMS and ARMISTEAD, such that no proper combination of the applied documents can render the instant invention unpatentable.

Further, Applicants note that as none of the applied documents of record identify the

problem that Applicants have solved by the instant invention, the applied art of record cannot even arguably suggest Applicants solution or render the instant invention obvious.

Further, Applicants submit that claim 26 is allowable at least for the reason that it depends from an allowable base claim and because it recites additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of ARMISTEAD and further in view of ROOKS teaches or suggests, *inter alia*, said analysis unit further including a testing mode, such that, in said testing mode, a pad image buffer, the set of testing algorithms, and the learned characteristic vectors with tolerances are transmitted to said analysis unit, and, in order to test a soldered joint, a correlation between the learned characteristic vectors with tolerances and the soldered joint under test is determined, as recited in claim 26.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claim 26 under 35 U.S.C. §103(a) and indicate that this claim is allowable.

4. Over Adams in view of Niklason

Applicants traverse the rejection of claims 30 and 36 under 35 U.S.C. §103(a) as being unpatentable over ADAMS in view of NIKLASON et al. (U.S. Patent No. 5,872,808) [hereinafter “NIKLASON”]. The Examiner asserts that, while not recognizing moving the X-ray beam in two opposite directions, NIKLASON discloses such a feature, and that it would have been obvious to modify ADAMS to include such a feature. Applicants traverse

the Examiner's assertions.

Applicants note that the sources 10 and 20 are fixedly mounted to the upper surface of "C" shaped bracket 604, such that sources 10 and 20 move together in scanning the test piece. Because sources 10 and 20 act as sources and receivers, this mutual movement enables the requisite receiving of the other sources signal. Thus, notwithstanding any disclosure of NIKLASON, Applicants submit that the art of record fails to provide any teaching or suggestion for modifying ADAMS in any manner suggested by the Examiner.

While the Examiner has made an unsubstantiated statement of obvious, the examiner has not shown any teaching in the art that teaches how one ordinarily skilled in the art would modify ADAMS to operate with oppositely moving sources 10 and 20.

Because the art of record fails to provide any teaching or suggestion for modifying ADAMS in the manner asserted by the examiner, Applicants submit that instant rejection is improper and should be withdrawn.

Further, Applicants submit that claims 30 and 36 are allowable at least for the reason that these claims depend from an allowable base claim and because these claims recite additional features that further define the present invention. In particular, Applicants submit that no proper combination of ADAMS in view of NIKLASON teaches or suggests, *inter alia*, said X-ray beam tube and said detector are adapted to move in opposite directions, as recited in claim 30; and linearly moving the X-ray beam tube and the detector in opposite

directions, as recited in claim 36.

Accordingly, Applicants request that the Examiner reconsider and withdraw the rejection of claims 30 and 36 under 35 U.S.C. §103(a) and indicate that this claim is allowable.

Application is Allowable

Thus, Applicants respectfully submit that each and every pending claim of the present invention meets the requirements for patentability under 35 U.S.C. §§ 102 and 103, and respectfully request the Examiner to indicate allowance of each and every pending claim of the present invention.

Authorization to Charge Deposit Account

If for any reason a check including the amount for any necessary fees is not associated with this file, the undersigned authorizes the charging of the amounts identified herein for the missing check, as well as any necessary fees not explicitly identified, including any extensions of time fees required to place the application in condition for allowance by Examiner's Amendment, to Deposit Account No. 19 - 0089 in order to maintain pendency of this application.

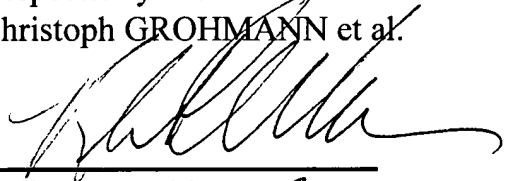
CONCLUSION

In view of the foregoing, it is submitted that none of the references of record, either taken alone or in any proper combination thereof, anticipate or render obvious the Applicants'

invention, as recited in each of claims 14 - 37. The applied references of record have been discussed and distinguished, while significant claimed features of the present invention have been pointed out.

Accordingly, reconsideration of the outstanding Office Action and allowance of the present application and all the claims therein are respectfully requested and now believed to be appropriate.

Respectfully submitted,
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